Development of Production PVD-AlN Buffer Layer System and Processes to Reduce Epitaxy Costs and Increase LED Efficiency

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Project Objectives

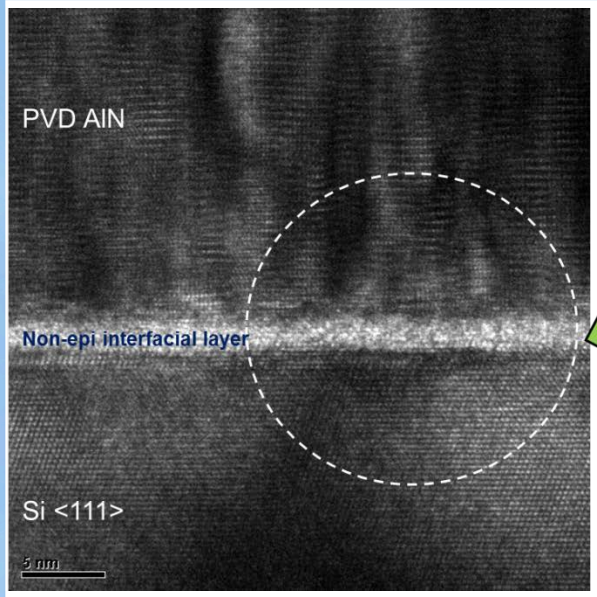
- 60% reduction in epitaxy manufacturing costs
  - Cost of Ownership reduction using higher throughput PVD AlN buffer
  - Reduction in defect density with PVD buffer (higher brightness)
  - Reduction in non-ESD yield loss through reduction in wafer bow and temperature variations
  - Enablement of GaN/Si processing with PVD buffer

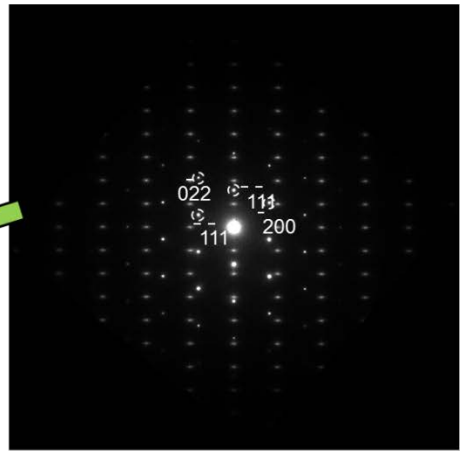
- Phase I – Process Development – GaN on Si
  - PVD AlN buffer for GaN on Si
    - Epitaxial growth
    - Protection of Substrate from subsequent GaN deposition (Ga chemistry)
    - Stress/Strain control
- Phase II - High Volume PVD AlN Buffer Tool
  - Design, build, qualification of system
  - Process transfer
- Phase III – Throughput Enhancement
  - In-situ cleaning capability
  - CoO Reduction demonstration

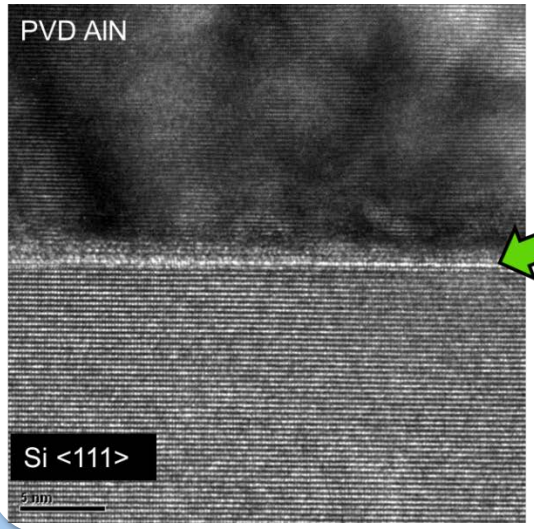
Year One

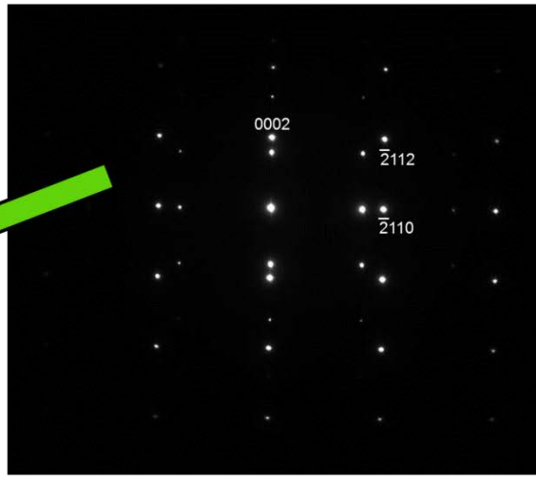
Year Two

Epitaxial Growth







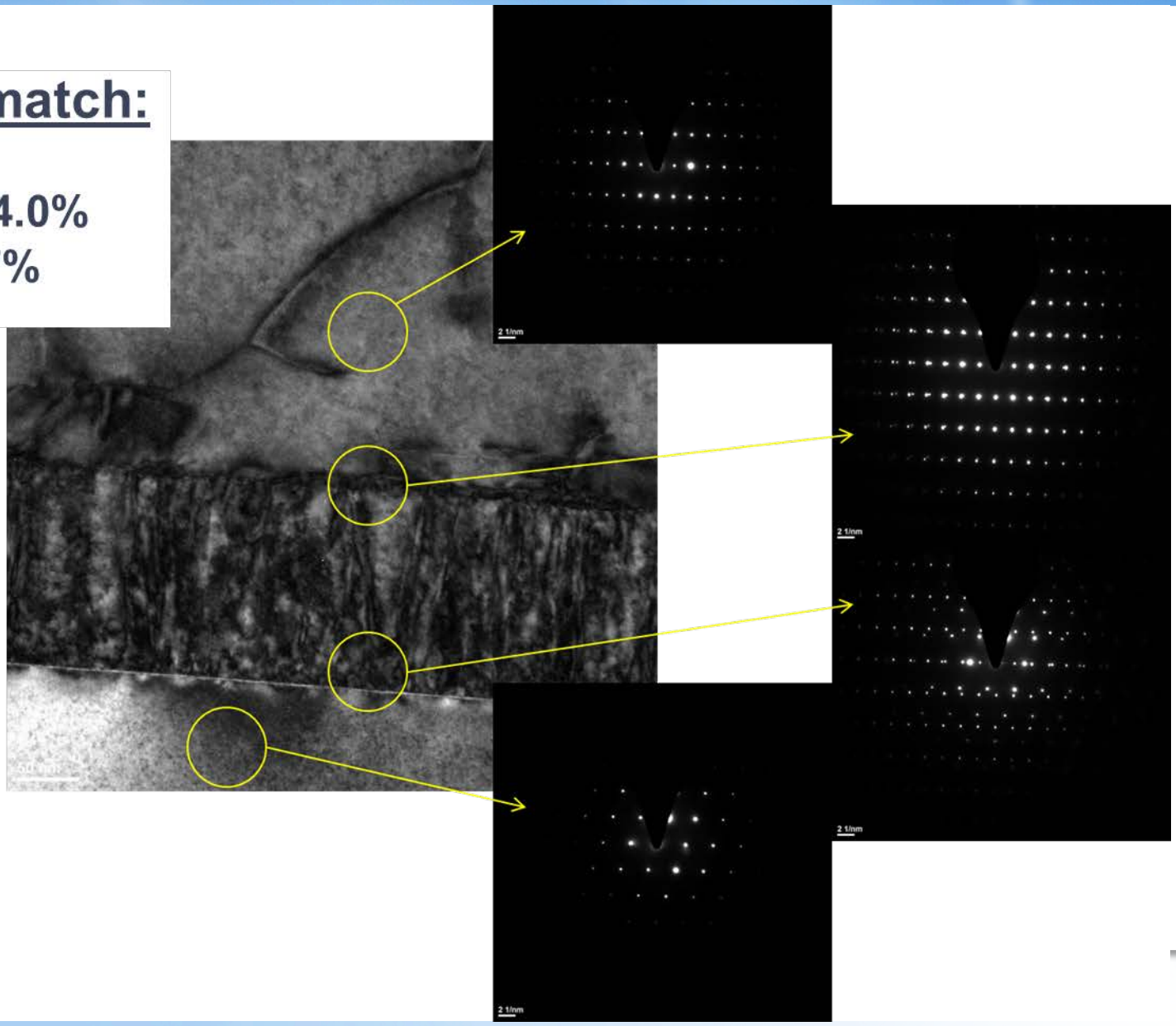


- Epitaxial quality buffer layers achieved with PVD deposition!!
- Further progress made to reduce non-epi interfacial layer and improve PVD AlN film quality

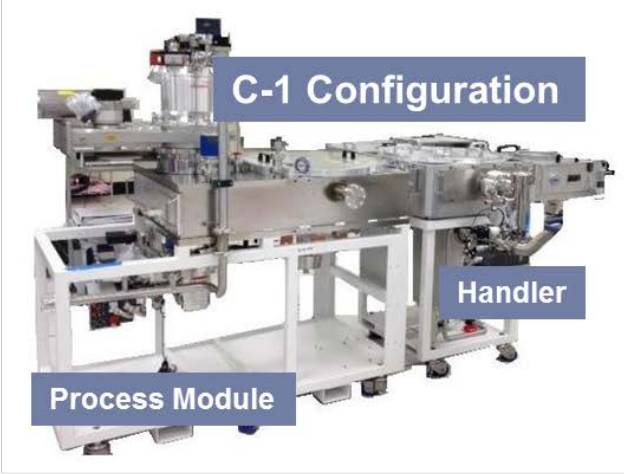
Epitaxial Growth

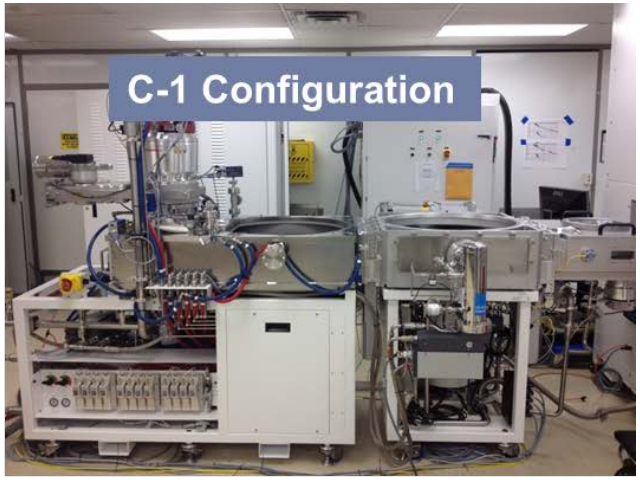
Lattice Mismatch:

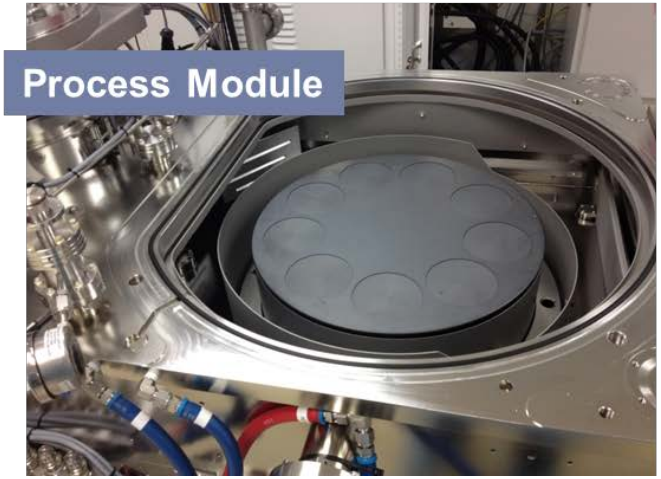
- GaN/AlN = 4.0%
- AlN/Si = 5.7%

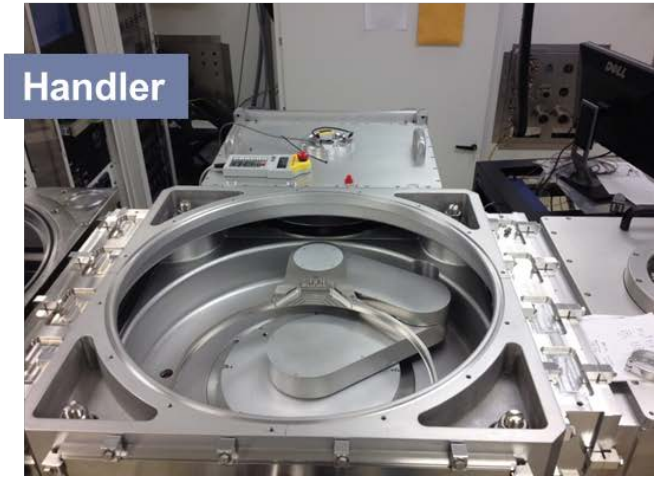


High Volume Manufacture PVD AlN Buffer Layer Tool System Currently Under Test









- High Volume Manufacturing System Development progressing to schedule

Conclusions

- All of the tasks for Phase I and II have been completed
- Two milestones to be met - achievable by September
  1. Further AlN film quality improvement
  2. Complete elimination of Si melt back to meet GaN targets
- Process qualification (demo readiness) by end of September